CHESAPEAKE BIOLOGICAL LABORATORY

MARYLAND

DEPARTMENT OF RESEARCH AND EDUCATION

ANNUAL REPORT
1948

R. V. TRUITT

EDUCATIONAL SERIES NO. 22

SOLOMONS ISLAND, MARYLAND

Reprinted from
Fifth Annual Report, Maryland Board of Natural Resources, 1948

State of Maryland

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Chesapeake Biological Laboratory Pier.

ANNUAL REPORT

DEPARTMENT OF RESEARCH AND EDUCATION

A—GENERAL

The research and teaching programs of the Department were expanded during 1948 and the personnel was increased accordingly. The functions of these programs were to encourage fundamental research, to further develop information as to applied conservation, and to diffuse knowledge concerning conservation principles and practices to the end of arousing the public to a fuller appreciation of the basic and enduring values of natural resources in social well-being. The work of the Department followed the general direction of that carried on in recent years. Certain of the studies were completed, while the program was expanded to included features looking to a complete inventory of all of the natural resources of the State under the administration of the Board of Natural Resources, that is, all resources exclusive of soils.

The Act that created the Department *(Chap. 508, Sec. 12D-12G, Acts of 1941)* provides, in part, that: "The supervision of the Department shall be vested in a Commission of Research and Education consisting of five members, to be appointed by the Governor, each of whom shall have had training and experience in scientific investigation and research, especially in the field of natural resources". The membership of the Commission during the year was Dr. B. H. Willier, The Johns Hopkins University, *Chairman;* Professor Franklin D. Day, Superintendent of Schools, Queen Anne County, *Secretary;* Dr. Ernest N. Cory, State Entomologist; Dr. Earle T. Hawkins, President, State Teachers' College (Towson); and Dr. Lloyd M. Bertholf, Dean, Western Maryland College. Dr. Bertholf resigned in February and was succeeded in April by Dr. Carroll B. Nash, Head, Department of Biology at Washington College. The Commission holds stated meetings in the Spring and Fall, and meets at other times as circumstances may require.

Headquarters of the Department are located at Solomons Island, Maryland, and its work falls into four major divisions; namely, the State Weather Service, the Chesapeake Biological Laboratory, the Natural Resource Inventory and Conservation Education, the first named being quartered in the U. S. Custom

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House, Baltimore. The Staff of the Department at the end of the year was composed of the following named:

STAFF

R. V. Truitt, Ph.D., *Biologist and Director*
G. F. Beaven, M.A., *Biologist I, Oyster Investigations*
G. N. Brancato, B.S., *State Meteorologist*
Coit M. Coker, M.A., *Biologist II, Fishery Investigations*
Alice W. Cronin, B.A., *Chemist III*
L. Eugene Cronin, Ph.D., *Biologist I, Crab Investigations*
Thomas S. DeLong, M.F., *Biologist III (Forestry)*
Harold J. Elser, Ph.M., *Biologist III (Aquatic)*
Marion E. Elser, *Senior Stenographer*
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Galen H. Maxfield, B.S., *Biologist II, Fishery Investigations*
Harvey Mister, Captain, *Fish Culturist, In Charge of Commercial Fish Hatcheries*
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Mary L. Sieling, *Senior Typist*
R. D. Van Deusen, M.S., *Biologist I, In Charge, Natural Resource Inventory*
Philip B. Whitford, Ph.D., *Education Assistant*
Doris Woodburn, *Secretary*

The crab, oyster, fish and hydrographic researches of the Department were continued from the previous year and at some points expanded. A comprehensive plan was outlined and largely implemented to the end of effecting a natural resource survey of Maryland, exclusive of soils. The conservation education program continued a college credit course for in-service teachers and developed a series of conservation workshops. The following pages set forth in more detail the procedures followed in these and other developments from the research and educational programs of the Department.

B—INVESTIGATIONS

1. CRAB

Blue crab research is aimed primarily toward attaining the maximum stabilized yield from the fishery. Achievement of this objective must involve several intermediate steps: (1) measurement of fluctuations in supply; (2) determination of the causes of those fluctuations; and, (3) as much human control of the causes as is possible. This is, unfortunately, a slow procedure. Genuine advance was made in 1947 toward the first of the intermediate problems.

A committee of technicians on the blue crab, composed of representatives of this Department, the Virginia Fisheries Laboratory, the U. S. Fish and Wildlife Service, and the Atlantic States Marine Fisheries Commission, has functioned actively and constructively. The Committee was established to coordinate all crab research in the Bay region and to provide administrative guidance. Several meetings were held during 1947. These discussions resulted in improved research effort and in sounder comprehension of research problems and methods. The Committee member from this Department specifically contributed a tentative evaluation of all the ecological factors which might reduce a new crop of crabs and a broad tentative research program for the blue crab investigations. Out of the meetings of the Committee arose an increase in the conviction that single species research is not adequate for the comprehension and management of aquatic resources. Thinking of this type culminated in the formation of the Chesapeake Bay Institute discussed in another portion of the report.

The Committee has not been able to answer all of the crab problems facing conservation administrators. The most pressing question continued to be whether or not increased exploitation would be harmful to future supplies. The Committee formally adopted the following statement: "We have no biological information to indicate the effect of increased exploitation on the total population." Part of the Committee feels, without scientific certainty, that ecological factors are so dominant in the control of crab abundance as to make fishery restrictions futile and, perhaps, wasteful. Another part of the Committee, including the member from Maryland, feels that any increase in the number of spawning crabs may be effective insurance against the worst effects of unfavorable environmental conditions.

Much scattered data on crab biology, abundance, and ecology exist. These data, relatively expensive, are wasted unless they are brought together and assimilated for the use of present and future investigators. The Committee has requested the help of two or three full-time clerical assistants to compile the data. Such help has not been possible administratively, thus the researches involved have failed of maximum efficiency.

Trot line samples have been continued as one of Maryland's contributions to the coordinated program. These yield quantitative data on the composition of the crab catch at eight key points in the upper Bay. These data are not listed herein since their greatest value lies in long-term continuity and since they are to be reported later on.

Every study of blue crabs in the past twenty-five years has resulted in the emphatic recommendation that adequate statistics

on crab catch must be collected. This Department instituted a new program in December of 1947 which should yield detailed biological data as well as valuable information on the catch per man per day by each gear in every area. The system is based on a carbon-copy of the purchases of each packing house, soft crab shipper or buyer. The form of the record sheet is shown in Figure 1. The Department furnishes the ledger and addressed stamped envelopes, supplied by the Department of Tidewater Fisheries, to the crab firms. These firms return their sheets at the end of each week. The program was generally well received by men of the industry and the response has been very good, although not perfect.

Certain specific studies have been made for the information of the Department of Tidewater Fisheries. Particular attention was given to the probable effects of extending and increasing the use of crab pots in Tangier Sound and the tributaries of the Bay. Field observations yielded the following generalizations: (1) potting increases exploitation; (2) potting usually increases the capture of small crabs, especially in shallow waters. Exploitation can be of obvious wisdom as in Tangier Sound where tagging has indicated that many large male crabs are present which do not migrate to other areas and are not caught by trot line. On the other hand, widespread exploitation has not been recommended as a broad state policy.

Pots catch a significant number of small crabs in any part of the upper Bay or tributaries. These are not easily culled, but must be returned to the water to avoid waste. A self-culling pot appears to be highly desirable. Preliminary tests were made in 1947 on several commercial wires which might be incorporated into the construction of pots to permit the escape of small crabs. One and one-half inch wire retains all crabs over four and one-half inches wide, and two-inch wire releases all crabs below five and one-quarter inches wide, so that neither is perfectly satisfactory. A commercial firm is manufacturing several types of special wires which will be tested in 1948.

The series of shallow bays along the Atlantic Coast of Maryland produce crabs. The supply in these bays varies tremendously for reasons not known. Local crabbers requested certain liberalization of the laws to conform to the Virginia laws which control part of these waters. An investigation was made and a report presented to the Department of Tidewater Fisheries in which were evaluated the feasibility of introducing crab pots, permitting the capture of sponge crabs, winter dredging, and the retention of all adult females regardless of size.

Several commercial problems were investigated during the year. A commercial storeable bait, "Loblure", was tested in

CONFIDENTIAL RECORD OF CRAB CATCH

DEPARTMENT OF RESEARCH AND EDUCATION, SOLOMONS, MARYLAND
IN COOPERATION WITH
DEPARTMENT OF TIDEWATER FISHERIES
AND
UNITED STATES FISH AND WILDLIFE SERVICE

COMPANY _____ ADDRESS _____

CIRCLE ONE FOR EACH NAME — P = POTTER, R = RUNBOAT OR TRUCK, T = TROTLINER, S = SCRAPER OR DIPPER

AVERAGE PRICE (OPTIONAL) [ ]

DATE	MON.	TUES.	WED.	THUR.	FRI.	SAT.	TOTAL	
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Fig. 1. Sample sheet from crab ledger.

crab pots during the periods when menhaden or other scrap fish are not available. This product caught some crabs, especially in water over twenty feet deep, but was distinctly inferior to fresh bait and inadequate for commercial utilization in these waters.

Early stage peeler crabs are caught in large numbers by soft crabbers. These peelers are near the moulting stage, but are usually subject to high mortality and low shedding success if held on floats. An attempt has been made to stimulate shedding in these crabs by damage to a tiny sinus gland present in the eyestalk. This gland is known to control or affect many physiological activities in other crustacea, including the rate of moulting. Experiments were conducted on several hundred immature crabs. A larger percentage of these animals sheds after sinus gland damage, but the increase was more than offset by excessive mortality among the experimental animals. The investigation yielded some important interesting data on crab physiology, but showed little or no possibility of commercial utilization. Improved techniques might make the procedure useful, but it has no value to the soft crab industry at present. These studies are being continued at Yale University.

Tagging continues to provide useful biological and administrative data. A comparison has been made of seven different methods of tagging the blue crab. The results, which will be published, show that the method now in use, described in the *1947 Annual Report,* yields the best returns. All tagging data obtained since 1925 are being assimilated for interpretation. The importance of juvenile tagging is readily recognized and a new method has been developed for marking small crabs so that the tag may be retained through the shedding process. Small pieces of red plastic are inserted between the walking legs into the muscles of the thorax. A few crabs, tagged by this method, shed successfully on floats and retained the tag, but the results were not conclusive. 505 crabs were so marked and released in Tangier Sound in September and the tags were widely publicized. No returns have been made, thus the efficiency of the technique is not completely determined.

Some of the projects described above are of continuing importance and will be maintained. Several additional problems will be added in 1948, including (1) the possible use of vital stains in marking juvenile crabs; (2) the accumulation of all literature on the blue crab and its close relatives; (3) the sampling of juvenile crabs at several points in Maryland; and, (4) increased attention to methods of measuring the crop of crabs hatched in any one year.

2. OYSTER

Observations of setting, fouling of cultch, growth, condition of meats, presence of natural enemies, mortality, population of

bars and environmental conditions continued to be major interests in the program of oyster research. A detailed survey and mapping of the oysters present on the charted bars of South River was undertaken jointly with personnel of the Department of Tidewater Fisheries and the U. S. Fish and Wildlife Service. Studies on the exposure of clean shells in half bushel bags, left overboard until the close of the spawning season, were expanded in the Spring of 1948. This work covered many areas where data of this type have not previously been gathered.

Salinity variations from year to year have been found to have marked effects on the condition of the oyster in Maryland waters and on the distribution of its natural enemies. November, 1947, marked the completion of ten years of continuous daily records of surface salinity and temperature at Solomons Island. Some five years of weekly samplings of both surface and bottom waters at a station near Solomons, at a depth of 60 feet, also have been recorded. Since Solomons is located about midway between the head of the Bay and the Capes and is little influenced by local run-off, its salinity pattern has been found to be strikingly indicative of the fluctuations occurring throughout most of the oyster-producing waters of the Maryland portion of the Chesapeake. The complete ten-year record has been plotted by months (Figure 2) and a smoothed average for the period calculated. This will provide a useful reference for more comprehensive study of salinity and temperature deviations from the normal pattern.

Oyster growth was excellent during the Fall of 1947, although the condition of the meats was not as good as during the preceding season. Very rapid growth was made in the Solomons area during early Spring of 1948, but with the beginning of warm weather, among the experimental oysters growing on trays at the Chesapeake Biological Laboratory, there was a general regression in which oysters formed a new growing edge or bill some distance back and within the thin frilly growth produced previously. An increased rate of mortality among these oysters occurred during this period.

The 1947 set of oysters was very good on St. Mary's River and Eastern Bay seed areas, but was poor on those of Holland Straits. At one of the stations in the St. Mary's River, the total set received by clean shells exposed in bags, replaced with fresh shells weekly, was calculated to be approximately 200,000 per bushel, a record for this area. The old cultch present on the bottom at the same location received a much lighter catch but, withal, a very good one. Counts made on Seminary and Gravelly Run bars, St. Mary's River, in November showed sets of 1,560 and 2,054 new spat per bushel, respectively, on the old 1946 planting of shells.

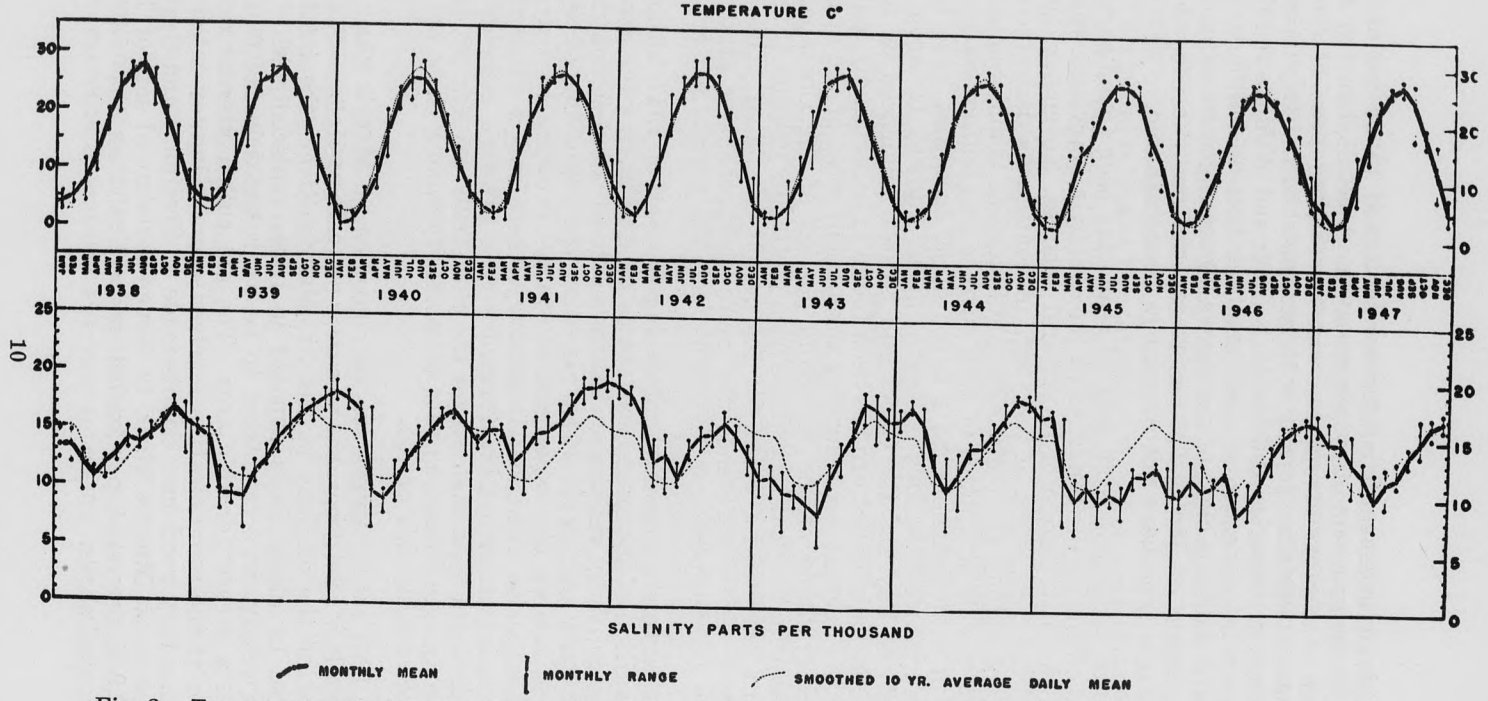


Fig. 2. Ten-year record of temperature and salinity of the Patuxent River at the Chesapeake Biological Laboratory.

Very light setting occurred on most of the oyster bars observed other than seed areas. Test shells changed weekly in the Bay, near the Patuxent River, received a cumulative set of approximately 700 per bushel ranging from early June to early September, while on natural cultch few spat were found. Setting was somewhat better on the eastern side of the Bay where counts on natural cultch ranged up to 106 per bushel at Stone Rock near Sharp's Island. There was an excellent set in Pocomoke Sound which ran as high as 1,820 per bushel on the 1947 shell planting on Marumsco bar. Growth was unusually good on this bar. The heaviest setting on it took place in early summer. Some of this set exceeded three inches in length by mid-November.

Fouling of planted shells was light in St. Mary's River during the 1947 spawning period, although bryozoa setting became moderately heavy after the oyster setting had ceased. Byrozoa setting was very heavy in the Patuxent region during July and August in which, at one station, an average peak rate of 32.8 colonies daily to a shell inner face was observed during the week of July 31 to August 7. A series of plantings of half-bushel shell bags at monthly intervals was begun during the Spring of 1948 on representative bars throughout the State. These are to be examined after the end of the spawning season to determine the extent of oyster set and the attachment of fouling organisms on clean shells planted at different periods and in areas where observations on commercial plantings are not available.

Continued periodic measurements have been made of seed oysters taken from different regions and held on special trays at the Chesapeake Biological Laboratory. This series of observations was expanded in the Spring of 1948 by the planting of seed from South Carolina, and from still other localities in North Carolina, Delaware and Long Island Sound. Experimental plantings also were made of seed oysters from two sources in which they were placed on the bottom and on trays in Chincoteague Bay in order to determine their rate of growth and mortality. A series of salinity and temperature records is now being gathered the year around in this area, together with other observations.

Experimental plantings of tin scrap, of three grades of slag and of clean shells placed in St. Mary's River on June 30, 1947, were examined in late fall. Large, medium and small grades of slag had counts of 1,488, 2,280, and 1,760 spat per bushel, while on shells planted at the same time, there was a count of 2,492. The spat on thirty-five sheets of tin scrap were counted and from careful measurements of the area of the original sheets it was calculated that the final set observed amounted to .14 spat per square inch. This compares with a set of .49 spat per square inch for shells put over at the same time and at the same location. Little fouling was present except for a few barnacles and some

accumulated silt. The tin had rusted little except along the cut margins which caused the segments to break apart readily. Thus far, the batches of scrap have remained in loose bundles such as characterized them at the time of planting.

The oyster bar survey in South River was preliminary in nature and intended to develop practical techniques which can be applied to a more accurate and rapid inventory of the oyster population on the various state bars. In it, the outlines of the old charted natural rocks were determined accurately and marked. A gridwork of squares laid off by dropping small buoys at 200-foot intervals in two directions across the bar was then made. At each of these small buoys an experienced tonger made five grabs with the size tongs best suited to the depth of water. Using the tables and method published by Dr. Graves in the Fourth Report of the Maryland Shellfish Commission, the number of bushels which could be caught per day at each point was calculated and a plot of the bar made showing the varying oyster concentration in terms of this yield per day. Data relative to the concentration of shells, the nature of the bottom, the depth of the water and the size of the tongs were recorded at each station. By further studies of the efficiency of the tongs, it may be possible to evaluate roughly the total oyster population of the bar. However, at present, an analysis based on the daily catch appears to be more accurate and practical.

Data on the composition of the oyster population on many typical bars of the State were gathered on the annual inspection of dredging rocks and on numerous visits to different areas during the year. Simpler and more accurate methods of scoring oyster condition, development of reproductive organs, abundance of fouling organisms, and other observations were formulated so that concise permanent records can be kept which will be uniform among the different agencies gathering oyster data in Maryland and Virginia. Numerous joint field trips and discussion meetings were held with personnel of the U. S. Fish and Wildlife Service, the Virginia Fisheries Laboratory and the Maryland Department of Tidewater Fisheries. These have served to coordinate and make more effective the oyster researches currently carried on by the respective agencies.

3. FISH

The fishery program pursued during the year embraced several problems, some of which were continued from 1947 while new ones were initiated. The major studies were: tagging, pond rearing and feeding habits of juvenile shad, shad hatchery and fry planting in the rehabilitative effort on Patuxent River, fish parasites of the area, scale sampling, Magothy River survey, statistical analysis of catches, and the operation of commercial hatcheries.

Further attempts were made during 1948 to tag successfully fingerling shad. To this end, fry were pond-reared at Fairlee through large fingerling sizes, approximately three inches in length. This experiment, a cooperative one with the U. S. Fish and Wildlife Service, whose method was used, was designed to develop an effective internal tagging procedure, especially to reduce or eliminate the high mortality that has been experienced in such work. An incision was made on the body wall of the fish through which a small printed plastic strip was inserted into the body cavity. Shad thus tagged were held over for a two-week period of recovery in outdoor wooden tanks of 300 gallon capacity filled with modified Ringer's saline solution which was constantly aerated. Some of the fish survived the full hold-over period and were released into Chester River. Nearly all of them placed in the saline solution survived for at least a few days. Controls held in a fresh-water tank died overnight. Low temperature was suspected of being one critical factor in causing mortality among the saline-held fish. The experiments could not be consummated until November, during which period air and water temperatures on several occasions approached the freezing point. This general method of tagging shad fingerlings is believed to hold considerable promise, if in future procedures, temperature factors can be controlled and further refinements in the chemical solution effected. Tagging and release of pond-reared fingerlings on a large enough scale would undoubtedly provide one means of evaluating a pond-rearing program in terms of contribution of such fish to the commercial fishery.

Study of the food habits of hatchery produced, pond-cultured shad was started during the 1948 season to determine the point in life at which the larval shad start to take in food. In the early stages, these fish have a prominent yolk sac upon the contents of which they depend for nourishment; thus, in addition to the initiation of feeding according to size and age of fish, there was concern as to the type of plankton used, factors seemingly important to successful rearing of shad in ponds. This problem involved, then, the time (size and age) when feeding starts, the type or types of planktonic food consumed at the outset of feeding, and the changes in food types, if any. Also, it was expected to determine what proportion of the total plankton present in the water was made up of the food types consumed. As indicated, the fry used were produced at the Fort Belvoir hatchery. The rearing pond used in the experiment was located at Lewistown, on Fishing Creek in the Monocacy watershed.

Experience accumulated during this and previous years in rearing shad fry to fingerlings stages has shown that such can be done effectively when definite conditions are met. Basic pond

requirements are fulfilled if the pond is drainable, seinable, free from predation, constantly accessible, and provided with an adequate water supply completely under control. Periodic addition of commercial farm fertilizers makes possible the establishment of an adequate food supply. Thus far, ponds available to the Department have not met all of these requirements, but sufficiently so to be indicative if critical work is to be done. Under conditions more closely approaching the ideal, there would be possibilities of obtaining extremely valuable information concerning shad without great expenditures of time, money and effort, to throw light on such questions as: (1) will release of pond-reared stocks help maintain the commercial fishery at sustained or more productive levels, a contribution that hatchery-produced fry apparently have failed to make? (2) what natural factors inhibit or favor survival of fry and fingerlings? (3) are there races of shad and, if so, what roles do environment and heredity play in establishment of their characters?

Attention was directed to parasites of commercial varieties of fish caught in the Solomons region. The survey, started in June and not yet completed, is preliminary in nature, and the qualitative and quantitative findings from it are to be announced later. Parasites of marine fishes heretofore have received relatively little study, especially in the Chesapeake area.

A trematode parasite, *Clinostomum marginatum*, new to shad, was discovered in fingerlings from the Fairlee pond and reported in the *Journal of Parasitology*. The degree of infection of these fish did not retard their growth. The parasite has since been noticed in shad pond-reared in widely separated areas. It is not an uncommon parasite among various species of fresh-water fish.

A survey of the Magothy River was begun for purposes of determining the relative abundance of fish populations in the river and to determine whether or not further restrictions are deemed necessary to maintain the existing fish populations under pressure from both sports and commercial fishing. The survey is being conducted along the following lines: (1) creel censusing is being made simultaneously on both the Severn and Magothy Rivers for purposes of comparison of the abundance of game species; (2) the Magothy Branch, together with tributary creeks, is being investigated in order to evaluate it as spawning and nursery areas; (3) as complete an investigation as possible, under time limitations, is being made of the commercial fishery in the Magothy River.

Cooperative operations with the U. S. Fish and Wildlife Service shad hatchery unit at Fort Belvoir, Potomac River, were continued. Maryland participated on a much larger scale than heretofore, having furnished five hatchery workers and a bi-

ologist, while the U. S. Fish and Wildlife Service supplied three workers in addition to working equipment. Activities commenced at Fort Belvoir on April 13th and ceased on May 21st. Shad eggs were first taken on April 17th, and collections were continued until May 19th. Shad eggs purchased from commercial fishermen as a salvage operation amounted to 23,917,000. An additional number, 217,000 eggs, was gathered by the hatchery crew. In all, 24,134,000 shad eggs were handled during the 1948 season. Due to brief failure of the water supply at one period of operations at Fort Belvoir, it was necessary to plant all incubating shad eggs then on hand, a total of 1,016,000 eggs being planted in suitable areas of the Potomac River. Approximately 828,000 shad eggs were transported to an experimental shad rearing pond located at Lewistown, Maryland. It is assumed that the eggs planted at Lewistown failed to hatch, since repeated towing failed to recover larvae.

A total of 19,027,800 shad fry was produced during the season at Fort Belvoir, representing a hatching efficiency of approximately 90%, exclusive of eggs removed because of plant failure. Of this number, 2,000,000 were released in each of Northeast, Choptank and Chester rivers. Three million were released in the Patuxent River in accordance with the ten-year restocking program initiated by the Department of Research and Education in 1940 to determine, if possible, the value of releasing fry to effect restoration of shad runs to that river. In the Potomac River 9,675,800 shad fry were released, while 200,000 fry were planted in two rearing ponds for experimental purposes. Fry mortality at Fort Belvoir amounted to 152,000 due to brief failure of the water supply at one period of the operation.

Of especial interest was the successful transportation by air of 1,148,000 shad eggs from the Potomac River hatchery to Damariscotta Mills, Maine, with little mortality during the six hours and forty-seven minutes enroute. However, these eggs were lost several days after delivery due to water supply troubles. The plan had been to hatch the eggs at Damariscotta Mills and plant them in the Abagadassett and the Dyer rivers in Maine, which regions previously had been surveyed and determined satisfactory for shad fry restocking. With knowledge gained by this experiment, plans are being formulated in Maine for future restocking of suitable streams there in an effort to restore shad runs, in which program this Department is pleased to cooperate.

The operation of hatcheries for commercial fish included, during the Spring of 1948, the yellow perch hatchery at the head of the Severn River where the box system was employed. Male perch were already present in numbers at the spawning ground

when hatchery operation was begun on March 1st. Female perch appeared the following weekend. First spawning occurred on March 9th. Production figures are given in the accompanying table.

SUMMARY OF SEVERN RUN PERCH HATCHERY OPERATIONS FOR 1948

Total boxes set out		396
Number quarts of eggs per box		4
Total quarts of eggs incubated		1,584
Number eggs figured per quart		100,000
Total eggs incubated		158,400,000
Hatching efficiency		85%
Total perch fry produced		134,640,000
Total perch fry delivered		79,200,000
Eastern Shore	37,200,000	
Western Shore	42,000,000	
Total fry planted in Severn Run		55,440,000

The statistical program, entailing the collection, tabulation and analysis of fin-fish catch records from all licensed commercial fishermen of Maryland, was continued over the past year. The program, started in 1944, now has available four years of detailed statistical information on the fin-fish industry of Maryland. The wealth of information and the versatility of the data will prove the program more valuable as each passing year's records are made available for a continued study of this important resource. Fishery statistics are becoming more generally appreciated by biologists in the study of the fishery, by the industry whose members use the procedures involved as a yearly inventory of their business, and also by those interested in the part played by the fishing industry in both the local and national economy.

Commercial fishing in the Chesapeake Bay area suffered a decrease of a half-million pounds during the past year (1947). This decline was due to an appreciable drop in the catch of river herring (alewives) and croakers, with minor losses in the catch of trout. Although the catch dropped somewhat in poundage. the value remained steady, due to a higher yield of two important species—striped bass and shad. Of the remaining species, bluefish, carp, catfish, white perch and yellow perch all registered gains over the 1946 production. The decreased yield of river herring was most acute in the upper Bay, while the loss in the catch of croakers was distributed over the entire Bay area. The 1947 season's output by the Atlantic Ocean fishery, centered at Ocean City, recorded a small gain over the 1946 figures.

The catch records collected by this Department are regularly supplied at the end of each calendar year to the Department of Tidewater Fisheries and are published by that Department as a part of its annual reports. The catch for 1947 is shown in Tables found elsewhere in this Report. It will be observed in

the data given for the Chesapeake Bay that nearly all of the resident species showed gains over the previous year's catch. Some of the migratory forms which leave Maryland waters and are caught by other fishermen showed a decline. Shad, an apparent exception among the migratory species, gained. Shad which spawn in Maryland waters are not believed to be caught elsewhere in appreciable quantities.

4. DIATOMS

Several significant lines of investigation on diatoms were carried on simultaneously during the period of July to October, when a rather heavy crop of diatoms prevailed in local waters and several types of special interest were found in abundance. Further collection and examination of materials was made to contribute to the general survey of the diatoms of the Bay, a work that has been in progress for several years.

Two trips were made to the area of Chincoteague Bay for the purpose of examining the extent of the algal growth there and of making collections of diatom material for a study of the flora of that area. Such a study is of particular interest because the unusual character of the Bay and its broad expanse of shallow water make of it a rich habitat for diatom growth; and the heavy growth of diatoms over this area would seem to have important implications in their relation to other life there.

Concentrated attention was given to the heavy epiphytic growth of diatoms over the weed beds near the mouth of the Patuxent River in the vicinity of the Laboratory, with a view to their succession, rate of development, extent of productivity, as well as conditions affecting the trend of this growth. At the same time, experimental study of the old problem relative to movement of diatoms was continued, a matter with several aspects of biological and oceanographic importance as well as of philosophical interest.

Experiments were also carried on looking to the successful development of a method of maintaining and following the activities of a single microscopic diatom cell or filament in the open water, a culture technique of special value for certain studies not so well adapted to laboratory methods. It should be indicated that this problem and the studies reported above represent investigations of a quite new character and with a number of seemingly significant potentialities.

5. CONOWINGO SURVEY

Work on the Conowingo Survey was resumed during the summer of 1948. Data were secured on temperature, oxygen, turbidity, pH and plankton. Netting experiments were carried forward. While the catch was small, as is typical during the

summer season, specimens were taken from the age groups desired, namely the two and three-year-old fish, and scales were obtained.

Sampling for juvenile and for forage fish was carried out in three areas. This was done by means of a 50-foot long, one-fourth inch seine. ,Satisfactory numbers of fingerlings of game fish were taken. Represented in the catches were both the large and the small mouthed bass and the black crappie. No wall-eyed pike were caught.

The incompletely correlated data present a picture of an abundance of food from the surprisingly high plankton counts to the strong suggestion that the game fish, notably the two kinds of bass, reach legal size within two-and-one-half to three years. It should be indicated, however, that much data will be needed from a number of consecutive years before the biological balance and trends of such a narrow channel reservoir will be understood.

6. HYDROGRAPHY AND CHEMISTRY

The hydrographic program was resumed in July, 1947, the work being restricted to the vicinity of Solomons due to the lack of a sufficiently large boat for use on extended cruises. The Bay work was confined within the limits of Cove Point and Cedar Point at a series of stations that transect the Bay eastward from each of these stations. The weekly sampling in the Patuxent River was continued with stations in the channel from Drum Point up-stream to Point Patience. The tide station on the Laboratory pier was maintained throughout the year with daily salinity and temperature records supplementing the continuous tide gauge record.

A newly acquired bathythermograph has proven satisfactory in recording water temperatures from surface to bottom. Water samples were taken at five meter intervals and analyzed in the laboratory for salinity and dissolved oxygen. The amount of oxygen in solution in the Bay water depths below 50 feet was found to diminish rapidly with the warming of the water. By July, the value had dropped to less than one part per thousand parts of water. This depleted area was found to extend, at times, up to the 30-foot depth.

Surface plankton tow samples were taken with the quantitative Clark-Bumpus net to determine the relative abundance cycles of the common microscopic organisms. During the cold months of January through March, a great abundance of diatoms was demonstrated in the tow samples. The major portion of the plankton population was made up, for a period, of a single species of filamentous diatom, *Nitschia seriata.*

Chemical determinations for the year included measurements of pH and density of waters from various streams of the State as part of the Resource Inventory program; measurements of salinity made periodically on water from certain oyster bars and crabbing areas; oxygen and alkalinity checks on water used in pond culture of fish; oxygen, pH, salinity and other tests on water from areas reporting mortality of aquatic forms. Continued determinations of oyster condition were made in conjunction with the oyster program.

A procedure was adapted during the summer of 1947 for the determination of calcium in the blood of the blue crab, *Callinectes sapidus* Rathbun. This work was carried out as a part of the study of crab molting, discussed elsewhere in this report. It had been suggested that the blood calcium level in *Callinectes sapidus* might indicate the molting stage of the animal. Results of the determinations made showed generally a rise in blood calcium of the crab prior to molting, and indicated a decrease immediately after molting occurs; however, it developed that there is too much variation for this method to be used as an accurate index to the molting stage.

7. CHESAPEAKE BAY INSTITUTE

Chemical and physical studies of the Bay have been in progress at the Chesapeake Biological Laboratory, sometimes effectively and sometimes in a desultory way, for several years. Since the properties and the nature of water determine its productivity and best use, it is necessary to have hydrographic information to better understand the fishery problems involved. The costly nature of this work when done comprehensively, and the isolated studies done to date account, in a large measure, for the lack of such knowledge about local conditions. Recognizing this situation, the governors of the two states, Maryland and Virginia, have seen fit to implement in a much fuller way a Bay-wide oceanographic program and, together with the U. S. Navy, have set up funds with which to create, at The Johns Hopkins University, a special agency to conduct such fundamental studies.

In placing the Institute at The Hopkins, it is recognized that advanced studies of common interest to Maryland and Virginia, to the interests and resources of the Bay, to the much needed sciences of oceanography and ecology of estuarial and shallow coastal waters might be developed to a high level. Shallow and embayed and estuarial waters have come to be recognized as extremely significant not only in local fisheries but in the national resources as well. It is in precisely the waters of this type that the greatest deficiencies in scientific knowledge and in trained men exist. The Chesapeake Bay Institute proposes to carry out studies and to offer advanced training in this highly

specialized field of state, national and international interests. The affairs of the Institute and its work are to be conducted under the administration of The Hopkins, thus assuring high academic and research standards. The interests of the states and the Navy, together with the thinking of the people in research and administrative work of the sponsoring agencies, will be reflected in the program of the Chesapeake Bay Institute, through having two representatives, each, on its Advisory Board and one, each, on its Executive Committee. Serving with the advisory group will be the Director, Department of Research and Education and the Director, Department of Tidewater Fisheries. The Director of the Department of Research and Education will serve on the Executive Committee.

Details of the administrative set-up to be employed and the comprehensive program which the Institute will follow have not been fully developed at this point, although funds have been appropriated ($90,000) for the first year of operation.

8. PATAPSCO PROJECT

Study of one type or another on the Patapsco estuary has been in progress over a period of years by several agencies of the State. During the summer of 1947, a reinvigorated and expanded program for the investigation of this body of water was started following a war-disturbed attack on the problem initiated in 1939. This new and more intensive study has been made possible through using industrial grants to support the project under the Department of Sanitary Engineering of The Johns Hopkins University. It is intended to develop fundamental technical information regarding the 13-mile stretch of the Patapsco River comprising Baltimore Harbor. It is anticipated that basic data obtained during the study will make possible the evaluation of factors imposing limitations upon usefulness of the estuary as a waste-receiving mechanism. With such information at hand, formulation of a policy of harbor use most compatible with interests involved will become possible.

Considerable field work was accomplished during the year. Hydrographic, chemical and bacteriological data obtained indicate the complex relationships existing between wind intensity and direction, water exchange, land water contribution to the estuary, waste volume and characteristics, location of outfalls, oxygenation, and deoxygenation, etc. Progress has been made on the hydrology of the harbor and on establishment of present pollution and salinity gradients in the basin. Because of the configuration of the harbor and the relatively small tidal ranges occurring at Baltimore, measurement of tidal and wind-induced currents with sufficient accuracy proved impossible of accomplishment using common current measuring apparatus, thus it

will be necessary to adapt special equipment for this purpose. Likewise, the presence of large volumes of industrial wastes complicated the techniques used generally in investigations of this type. Progress was made, however, and it is anticipated that work during the year ahead will cast much additional light on some of the factors involved.

Data gathered during the year disclose that at Baltimore, winds play a major role in mixing and moving harbor water masses; that under normal conditions much of the tidal water entering from Chesapeake Bay is not useful as a diluting agent of waste; that the estuary exhibits a tremendous capacity for accepting domestic or industrial wastes without production of seriously objectionable conditions once these materials get into major water masses; that considerable recovery from pollution is evident over the harbor length; that certain water bodies contiguous to the main harbor and bounded by numbers of industrial plants are markedly degraded by the discharge of wastes therein; and that a considerable concentration of certain pollutants exists in the bottom mud of the harbor.

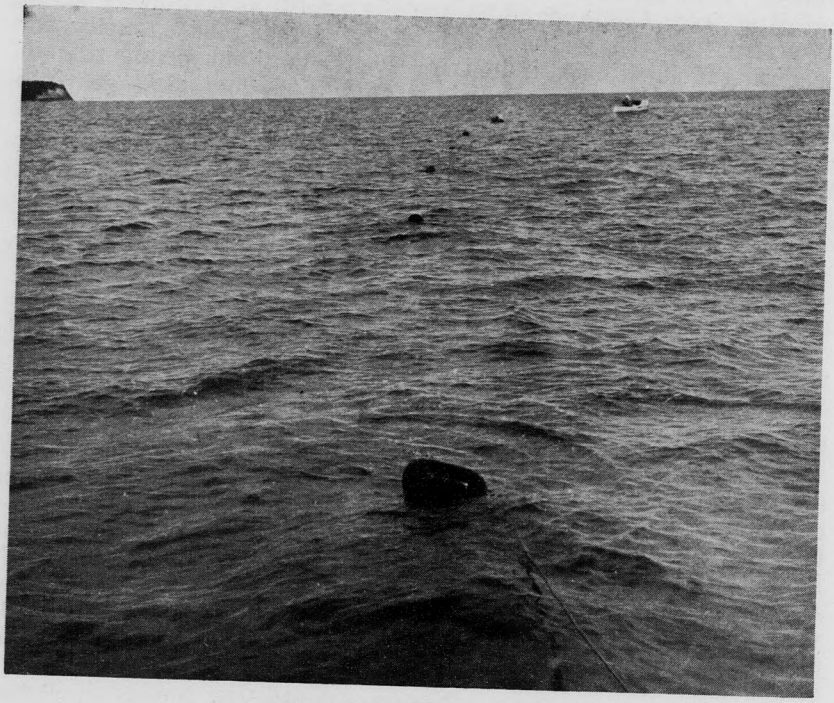
During the second year of this study, it is planned to investigate the efficiency of the harbor as a waste treatment unit to determine the extent to which present conditions are stabilized and to enable prediction regarding effects of increasing or decreasing waste volumes currently discharged to the estuary.

9. EFFECTS OF EXPLOSIONS

Data accumulated on the effects of underwater explosions, already reported, in which fish, oysters and crabs were held in experimental cages at known distances from the point of detonation, have been analyzed and prepared for publication (Bulletin No. 70, *Effects of Underwater Explosions on Oysters, Crabs and Fish*). Most of the charges employed in the cooperative work with the U. S. Navy weighed 30 pounds; a few weighed 300 pounds and a few others weighed 1,200 pounds. Some general conclusions drawn from the study, regarding fin-fish, are: (1) damage to fish exposed to underwater explosions is characteristic and readily recognized on *post mortem* examination of the viscera; (2) different degrees of damage can be perceived; (3) when extent of damage is plotted against distance, a typical injury or response pattern is apparent; (4) some species appear to be more susceptible than others, and each species may have its own response pattern variant from the fundamental pattern; (5) larger sizes of charges do not cause proportionally greater damage; (6) immediate lethal damage was restricted to 300 feet radius from point of detonation when 30-pound charges were employed; (7) the effect of explosions on oysters and crabs appears to be of no great serious consequence.

The Bureau of Ships, U.S.N., began in May, 1948, special

underwater explosion tests in Chesapeake Bay that continued through to September. On invitation of the Navy, the Department participated in the tests to determine, if possible, the extent of damage to fish life. Size of the charges employed varied from 250 pounds to 1,200 pounds HBX, the average being about 700 pounds and the depth of suspension below the surface being about 75 feet, in water depth of 156 feet. Certain features set this work apart from other explosion studies in that they were carried



Site of explosion tests.

out in water of greater depth (156 feet) and in that presence of several large vessels in the nearby vicinity provided reflective sources which appeared to disseminate effects of the charges over a wider area than heretofore encountered. Qualitative and quantitative counts were made of killed fish that appeared at the surface. Results of observations made during attendance at these explosions are to be published. Apparent damage to fish life was not extensive.

The predominant species affected was menhaden—a fish that is abundant, although used very little commercially in the State.

Other studies of effect of underwater explosion on fish life were carried on cooperatively with the Navy in its continuing experiments in the Patuxent River. The results of this year's observations are being combined with those of last year's for publication.

Interest in damage to fish life by explosive charges in recent years has risen. The problem early gained attention when seismal explorations for oil were extended beyond dryland shores. With

Experimental fish cage used in explosion tests.

the expansion of military interest in underwater explosive tests of various sorts, it was recognized that more factual knowledge was needed to evaluate properly claims and counter-claims so as to recommend future practices which would bring into harmony the values of relative interests. Observations made thus far in Maryland indicate that the damage to fish life by underwater explosion experiments at the current scale is not as great as often is claimed by commercial and sports fishermen. The maximum explosive kill observed in Maryland appears to have been less than that of a successful pound netter operating one gear. However, experience of observers of the Department of

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Research and Education has indicated that the field explosive damage to fish life is one open to, suggestive of, and much in need of proper evaluation, which will require further critical experimentation. Controlled scientific experiments already carried out by the Department have done much to delineate expected damage to a known number of fish subjected to known charges over limited distances. However, the value of surface counts of fish killed during routine explosions remains to be demonstrated, for there is evidence that some species and sizes of fish and a proportion of the total population lethally affected, appear at the surface not at all or only briefly. Other practical considerations may require adjustment of explosive tests, wherever feasible, to seasons when fish kill would be least in the area involved. From a purely scientific standpoint, several problems are in need of solution, among them being the exact manner in which damage is effected. Further experimentation in explosive effects is being planned in which the cooperation of the Navy is being sought.

10. OTHER STUDIES

Several problems of interest were pursued as adjuncts to or offspring from the major features of the research program, some of them being highly abstract, including observations on specific organisms, both plant and animal. A comprehensive survey of the fungi, marine, freshwater and land, in the region of Solomons Island was begun, as a result of which several hundred species in this group have been determined. Fish mortalities, water sampling in areas of disturbances, degree of abundance of new year classes, bird censusing and still other items of study were carried on as in the past.

11. OVER-ALL RESEARCH PROJECTS

The major researches of the Department in Progress and the projects immediately in prospect at the end of the year are listed below.

Composition of the commercial fish catch. A study to determine what year classes are entering into the catch and in what proportion, which, with other pertinent facts will contribute to the evaluation of the success of the Maryland Fisheries Management Plan.

Biological studies of certain species of commercially important fish; life histories, migrations, growth rates, effect of fishing on spawning stocks, etc.

Correlation of fingerling striped bass abundance with catches in year classes as indicated by annual sampling of juveniles and the commercial yields.

River temperatures. A study of water temperature fluctuations at the spawning grounds of shad during and after spawning season; includes comparison of two rivers.

Pond rearing of commercially important fish, involving production of fingerlings (chiefly shad) for some or all of the following: (a) release to the fishery, (b) racial studies, (c) migration studies, (d)

food studies, (e) brood-sex ratios, (f) studies of the influence of environmental factors on the survival of fry and fingerlings, (g) development of effective tagging or marking methods, (h) study of the effect on the fishery of the release of pond-reared stocks and (i) determining optimum fertilization conditions for maximum production of fingerlings.

Commercial fish hatchery operation; production of shad and yellow perch fry for release in various waters in the State. Involves evaluation of efficiency of hatchery procedures in rehabilitation of fisheries.

Maryland-fin-fish statistical program: collection of data in progress since 1944, on the catch of Maryland's commercial fin-fish production by species, water area, and gear, based on daily reports from fishermen; to be used as basis for judging the results of conservation practices, as well as for the biological and economic study of the fishery.

Survey of Magothy River, to discover facts concerning fish and fishing, both sport and commercial, in order to evaluate management procedures.

Artificial stimulation of hard crabs and early peeler crabs to moult; trial of several experimental techniques which have induced moulting in other crustacea.

Migrations of the blue crab; study, through tagging, of the interstate and intrastate movements of crabs.

Testing of several methods of tagging juvenile crabs in an effort to obviate the loss of markers in the molting process.

Statistical survey of the Maryland blue crab industry, including daily catch statistics, of each crabber as forwarded weekly by the packing houses. (Coordinated with a similar project of the Virginia Fisheries Laboratory.)

Increasing the efficiency of the crab pot; development of semi-artificial bait for pots and of a self-culling pot.

Measurement of fluctuations in the supply of blue crabs and their causes; quantitative measurement of the number of crabs produced each year and study of the factors which control the size of the population.

Survey of mud crabs in Chesapeake Bay, including determination of species, distribution and certain data on life histories.

Comparative growth rates and mortality of seed oysters obtained from diverse geographical localities ranging from South Carolina to Rhode Island, when planted under the same conditions at Solomons.

Adaptability of various oyster seed to growth in Chesapeake Bay waters through experimental tray plantings.

Attachment, survival, and rate of growth of oysters on shells, slag and other cultch on (a) seed areas, (b) shelled producing bars, and (c) seed plantings.

Studies of comparative growth of State produced seed oysters under different environmental conditions.

Rate of attachment of oyster spat and of fouling organisms to test shells exposed periodically in various State waters, with special emphasis on seed areas.

Oyster investigations dealing with (a) parasites, (b) predators, (c) bar composition, (d) oyster condition, (e) larval distribution, and (f) certain environmental factors.

Life history, distribution, and possible lethal effects of *Nematopsis* sp. on oysters in Chesapeake Bay area; (a) histological study of the organism; (b) microscopic examination of fresh material.

State-wide inventory of the salt and fresh-water fin-fisheries, oyster fishery, and crab fishery. Includes determination of (a) net fishing in tidewater by those not required to have a license; (b) sport

fishing in tidewater; (c) sport fishing in fresh water, as well as distribution of forms which make up the catches.

Hydrographic study of segments of Chesapeake Bay tidewaters; a determination of the physical and chemical variations in the waters of the Bay and their relationship to the organisms living therein.

Hydrobiological survey of the Conowingo Pool of the Susquehanna River.

Systematic survey of the algae of Maryland.

Survey of the diatom flora of the Chesapeake Bay.

The problem of movement in diatoms.

Survey of fungi, land and aquatic, in the Solomons Island area.

State-wide inventory of the forests of Maryland; (a) by collection and organization of backlog of information on pertinent forest studies. forest exploitations, and present remedies; (b) by use of photo-classification methods, determination of extent and types of forested areas and revision when areas are reflown; (c) by means of ground checks of systematically chosen area plots, determination of annual forest growth, amount of merchantable and non-merchantable timber, value of restocking, and value of certain areas to wildlife.

Evaluation of programs for forestry conservation established under the Maryland Forestry Conservancy District Act.

State-wide inventory of game birds and mammals to obtain the following: (a) check-list of species and their distribution; (b) game-kill statistics; (c) census of present and potential populations of game forms; (d) relative productiveness or carrying capacity for the various regions.

Determination of the essential values inherent in the Maryland Farm Refuge Program.

State-wide inventory of the surface water resources with emphasis on the following: (a) assembly of current information; (b) development of program to collect information on temperature and water quality readings for 150 stations throughout the State; (d) compilation of up-to-date map coverage and stream-system statistics.

Evaluation of methods of presenting conservation subject matter in class and workshop at in-training and in-service teaching levels.

Establish relationship between conservation materials or published matter and levels of instruction in the public schools of Maryland. (With cooperation of teachers).

Preparation of pilot publications and visual aids for teacher and for school use at different levels. (With the cooperation of teachers).

An appraisal of high school marine conservation club work in Tidewater Maryland. (Cooperation of Professor Harry Hughes, Superintendent of Public Education, Calvert County).

Approach to seafood conservation through the schools of Dorchester County (Cooperation of Professor Theodore Boston, County Superintendent of Schools, and Dr. James E. Spitznas, Director of Instruction, State Department of Education) in which classroom instruction and practical application under field conditions, are to be employed in an effort to effect desired understanding and practices.

C—NATURAL RESOURCE INVENTORY

It is generally recognized that resource management, like business management, requires knowledge of stocks on hand as a starting point in the formulation of sound, long range programs, whether they be concerned with development and use of

fish or fowl, soil or water, tree or bird. To this end, the Department of Research and Education has initiated a study looking to the acquisition of a comprehensive body of knowledge, not now

Field crew inventorying game.

available, concerning the abundance, type, quality and importance of the many and varied natural assets of the State. The information obtained from the study is to be made available in its entirety to the Board of Natural Resources and its subsidiary Departments, together with the State Soil Conservation Service and the State Planning Commission, which agencies administer the different programs of the State.

It is planned that in due time the Resource Inventory will provide a comprehensive understanding of the extent and worth of the natural resources and the part they play in the socio-economic well-being of the State. The Inventory will serve not only to point out the value of current resources, but also to project the potentialities of these resources through suggestions for the continuation of existing sound policies of management and for the institution of new and possibly better long range programs of management and administration. The process is expected to be a continuing one, including resurveys, in which some emphasis will be placed on problems commonly recognized as

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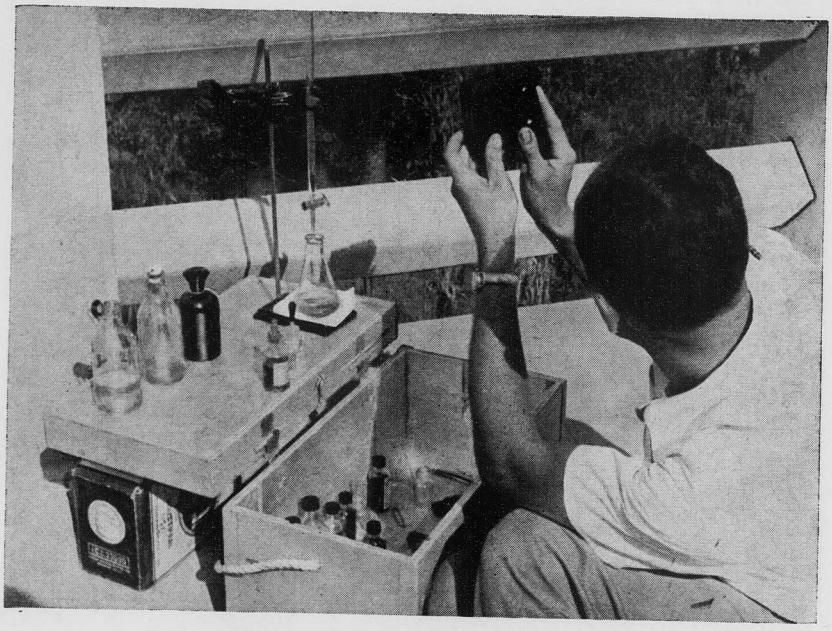
needing early attention, such as the existing problem of pollution. It is planned to organize from time to time, as the work progresses, the data that accrue from the study and publish them for public use.

The inventorying in the initial phases of the study will proceed water-shed by water-shed, into which classification the State lends itself to seven major divisions and several minor ones. This

Observing results of net haul.

approach through study of coherent and contiguous units makes for greater coordination of effort and manpower use, and for more effective inventory of particular resources as well as their relationships to the general resources of the region. That is, they can be brought into proper perspective in relationship to their interdependence and to the over-all conservation problem. In this connection, it should be indicated that the problem of soils, the inventorying of them and their best use is an outstanding one, although this feature of the conservation program of the State has been more extensively treated than other segments of the work, with consequent showing of results. How the soil conservation problem can be furthered by the present program, and conversely, is a matter that is to receive special consideration and treatment in view of the fact that such work is basic to all phases of conservation, while it is administered by an agency not subsidiary to the Board of Natural Resources.

Attempts are being made to bring together and coordinate information on the water resources. In order to obtain a general picture of the water areas, the following projects are being pursued: (1) one hundred and forty-seven sampling stations have been established on the major and type streams to determine their water quality; (2) information is being collected on the different phases of the State's water resources and indicated on detailed quadrangle maps, while (3) classification of water areas with regard to pollution and to fish productivity is in progress.



Water quality determinations.

An extensive survey of the forests of the Monocacy watershed is underway. From random sample plots in this area, growth data are being recorded of timber types and species. Plans have been matured for an aerial survey of Garrett, Allegany, Washington and Frederick counties' forests, with the cooperation of the Department of State Forests and Parks and the U. S. Forest Service. This project, it is planned, will cover ultimately all of the counties of Maryland.

A survey of the fishery in the Monocacy River system is being conducted. Emphasis here is being placed on: (1) creel census of the area to determine the fishing success; (2) seining and netting to determine the species composition; (3) growth studies

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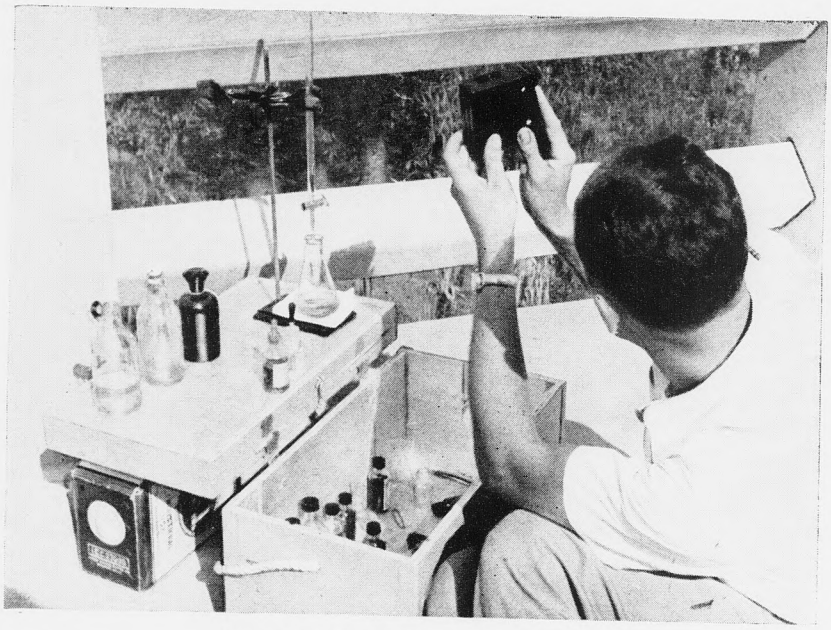
Observing results of net haul.

approach through study of coherent and contiguous units makes for greater coordination of effort and manpower use, and for more effective inventory of particular resources as well as their relationships to the general resources of the region. That is, they can be brought into proper perspective in relationship to their interdependence and to the over-all conservation problem. In this connection, it should be indicated that the problem of soils, the inventorying of them and their best use is an outstanding one, although this feature of the conservation program of the State has been more extensively treated than other segments of the work, with consequent showing of results. How the soil conservation problem can be furthered by the present program, and conversely, is a matter that is to receive special consideration and treatment in view of the fact that such work is basic to all phases of conservation, while it is administered by an agency not subsidiary to the Board of Natural Resources.

Attempts are being made to bring together and coordinate information on the water resources. In order to obtain a general picture of the water areas, the following projects are being pursued: (1) one hundred and forty-seven sampling stations have been established on the major and type streams to determine their water quality; (2) information is being collected on the different phases of the State's water resources and indicated on detailed quadrangle maps, while (3) classification of water areas with regard to pollution and to fish productivity is in progress.



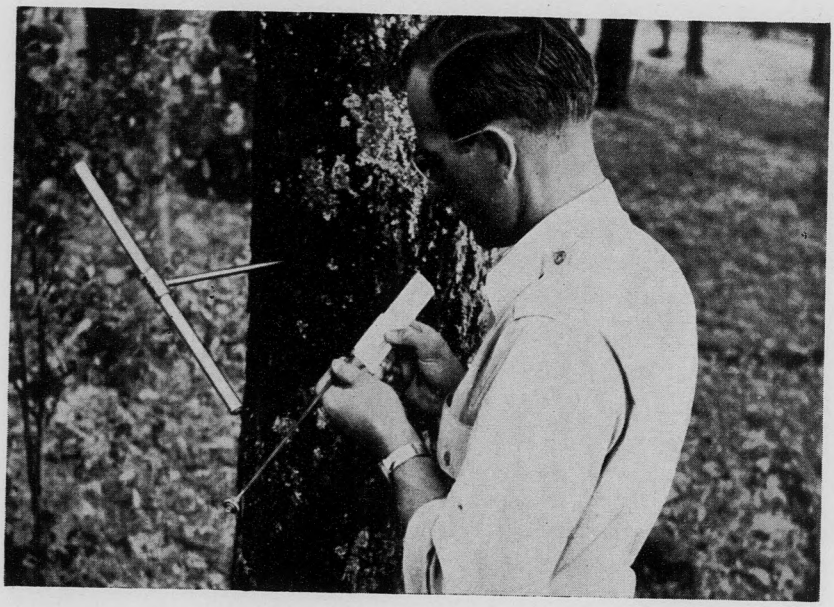
Water quality determinations.

An extensive survey of the forests of the Monocacy watershed is underway. From random sample plots in this area, growth data are being recorded of timber types and species. Plans have been matured for an aerial survey of Garrett, Allegany, Washington and Frederick counties' forests, with the cooperation of the Department of State Forests and Parks and the U. S. Forest Service. This project, it is planned, will cover ultimately all of the counties of Maryland.

A survey of the fishery in the Monocacy River system is being conducted. Emphasis here is being placed on: (1) creel census of the area to determine the fishing success; (2) seining and netting to determine the species composition; (3) growth studies

from scales with substantiating length and weight data; (4) routine checks on reproduction of game species, bottom food and forage, and examination for parasites.

The wildlife feature of the inventory is in the stage of organization. Plans to this end include a game inventory in which recent aerial photographs are to be used as a base in making ground-cover maps of random sample plots, this to be supplemented by subsequent censusing of game by observation while mapping the areas and by use of questionnaires filled out through personal contact with the resident landowners.



Forest Tree Growth Study.

D—WEATHER SERVICE

The function of the State Weather Service is to augment and supplement the rather general services of the U. S. Weather Bureau, thus making warnings and detailed forecasts of weather available to agricultural and business interests in all parts of the State, and to provide additional and specialized services to agricultural, horticultural, and other agencies for research or other purposes as needs arise.

This segment of the Department's work, in cooperation with the U. S. Weather Bureau, is providing a valuable service throughout the State (1) by making special studies of its varied climatic conditions and their influence upon the welfare of the

people, (2) by collecting, processing and publishing detailed weather forecasts and warnings to agricultural, fishing, transportation and general business interests.

The number of weather stations maintained in the State decreased during the war years from, approximately, 70 to 60. Through the aforementioned cooperative program, it was possible during the year to increase the number of stations to 75, thus making available to agricultural interests weather data for additional sections of the State. These stations are operated by cooperating, highly interested observers who work on a voluntary basis and without pay. Data collected from the stations, at weekly intervals, serve as a basis and guide for determining the suitability of given areas for certain business interests or special agricultural products. Also, they serve in the study of the growth of various types of crops, the control of insects and diseases, and to provide general information on the climatic variations over the State for engineering and other purposes.

The equipment of a typical station includes a maximum and minimum thermometer for recording daily extremes of temperatures, a rain gage which measures rainfall to within one one-hundredth of an inch, and an instrument shelter for housing the thermometers. All necessary forms are provided to the observer who makes one daily reading of the following factors: maximum and minimum temperatures for the preceding 24 hours; temperature at time of observation; total rainfall for preceding 24 hours; types of weather such as snow, rain, fog, etc., as they occur; special notes on frosts, storms, or unusual types of weather and general information on crops, if such is available. The station reports are sent in every seven days and are used in a weekly summary of weather and crop conditions which is published cooperatively by the Maryland State Weather Service, the U. S. Weather Bureau, the State Department of Markets, and the U. S. Department of Agriculture, Division of Statistics. Producers, canners, farmers, transportation interests, mariners and the general public are thus kept advised as to the crop and weather situations over the State.

A cooperative agreement between the Maryland State Weather Service, the U. S. Weather Bureau and the Maryland State Police provides for daily dissemination of forecasts and warnings for each county through use of the State Police teletype system. These forecasts are transmitted to all State Police barracks at 8:30 A. M. daily, and, in turn, made available to county agents' offices, newspapers, and radio stations for dissemination to agricultural interests and the general public. Thus, there have been provided to the people in every county detailed daily forecasts applicable to their particular area for use in planning daily operations.

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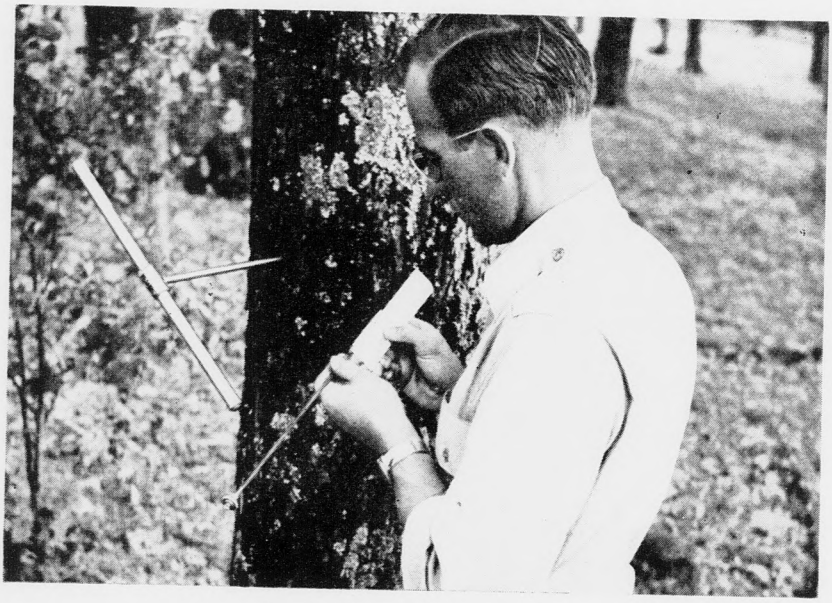

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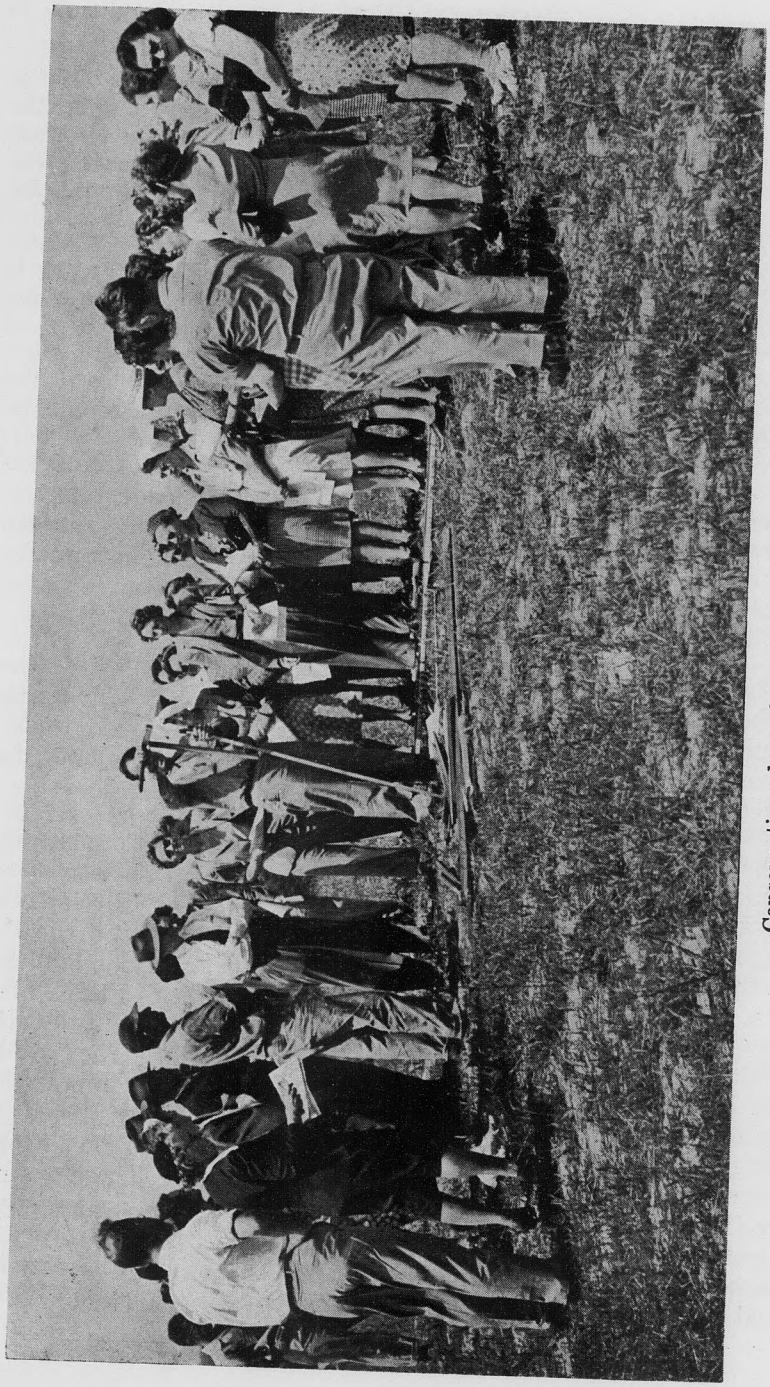
E—EDUCATION

The three semester-hour course, "Conservation of Natural Resources", was conducted during the Fall term, as in the past, in which credit was provided at the University of Maryland. Classes in four sections, on the basis of two clock-hour lectures and a three-hour laboratory were held at Cambridge, Salisbury, College Park and Bowie with a total registration of 136, for the most part in-service teachers. As in previous years, the registrants did field work at a State Forest and at the Chesapeake Biological Laboratory to observe first-hand the many conservation problems and their solution, involving water, soil, forest, game and the fisheries. The course was not offered during the Spring term, 1948, due to difficulties that arose at College Park concerning the evaluation of credit. All agencies of the Board of Natural Resources and the State Soil Conservation Service participated in the formal class work through the assignment of well chosen specialists to conduct the lecture and field work.

Many teachers, specialists, club people, college groups, the enforcement personnel, and official conservationists used the Chesapeake Biological Laboratory and its dormitory facilities for conferences, short courses and special sessions during the year, in which their programs were arranged as a part of the Department's educational work. Typically, the same instructional staff was used in these programs as in the credited course. This type of work was exceptionally well received and it appeared to meet a marked need.

Demands on the Staff for lectures, demonstrations and help with club and radio programs continued during the year while the specialists in all branches of the program worked in close harmony with the different conservation agencies of the State as their advice and services were requested. Also, the members continued to serve as technical advisors with local conservation groups and organizations. They met in consultation or in an advisory capacity with representatives of neighboring states and with the Fish and Wildlife Service in order to effectuate cooperative effort on related problems as well as to exchange ideas and techniques for common good. Several members served in their respective fields as technicians with the Atlantic States Marine Fisheries Commission.

Some additions to facilities for the presentation of conservation education materials were made during the year, especially in photographic and projection equipment. However, there was not built up an anticipated volume of prints and slides such as that needed in class room and for demonstration. This phase of the program remains weak, although with added equipment and



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Conservation class observing soil survey.

with more extended field work in progress the condition is expected to be remedied to a large extent.

The formal course, *Conservation of Natural Resources,* is given, typically, in a county seat or a teaching center upon the request of the Superintendent of Schools. Up to the current period, it has been provided by the Department of Research and Education to Washington, Frederick, Carroll, Montgomery, Prince George's, Calvert, Dorchester, Somerset and Wicomico Counties, while it has been repeated in Baltimore and at College Park some three or four times since the initiation of the work in 1943. The success of this teaching effort has been due in a big measure to the support given it by the State Superintendent of Schools and the County Superintendents, together with their associates, who recognize the need of having the children of the State become aware of the problems inherent in the use of natural resources and the matter of perpetuity of the resources. Teachers appear eager to take the course. They indicate that it has marked value in pointing up their own thinking and knowledge, and that it has decided inspirational value in the class room in all subjects and at all levels. Furthermore, the teachers are almost unanimously of the opinion that the credit value of the course lies at not less than the advanced undergraduate-graduate level.

The program projected for the year ahead includes, in addition to the college credit course in conservation to be held during the regular school terms, a series of workshops to be held weekly during the summer of 1948. These are intended primarily for in-service teachers and administrators.

A club whose membership is composed of Calvert County High School boys, "The Students' Marine Conservation Society", was organized and started to function during the year, through the cooperative effort of the County education officials and the Department. Membership in this group rests primarily on studentship, interest and, to some degree, upon proximity to the water. The members meet weekly at the school and monthly at the Chesapeake Biological Laboratory or on field trips. They study, first-hand, the problems of marine conservation. An outstanding project of theirs has been the planting of two different beds of oysters, a total of approximately 4,000 bushels of seed, on bottoms conveniently located and well suited to the purpose. These oysters are the property of the Club. They are being observed systematically as to survival, quality and rate of growth in order to learn the problems inherent in oyster culture and to appraise the local oyster situation in terms of management.

F—PUBLICATIONS

The results of the more important work done by the Department's specialists are printed in two categories, the *Educational Series* and the *Publication Series,* the former being concerned, as implied in the term, with the education program and the latter with the researches. During the year, the following publications, listed by series, number, title and author, were issued:

Publication Series

69 Maryland Fisheries Statistics, 1944-1945—Ralph C. Hammer, Harry A. Hensel and Richard Tiller, 1948.

70 Effects of Small Underwater Explosions on Oysters, Crabs and Fish—Staff, Chesapeake Biological Laboratory, 1948.

71 An Ecological Study of the Seasonal Distribution of Ostracoda, Solomons, Maryland, Region—Willis Tressler and Essie M. Smith, 1948.

72 Studies of the Effects of Industrial Pollution in the Lower Patapsco River Area. 2. The Effect of Copperas Pollution on Plankton—Charles C. Davis, 1948.

Educational Series

17 Maryland Forests and Forestry—Findley Burns, 1948.

18 Maryland Farm Woodlots—Adna R. Bond, 1948.

19 Inventory Plan, Maryland Natural Resources—R. V. Truitt, 1948.

20 1947 Annual Report—R. V. Truitt, 1948.

The publications of interest to specialists in the different fields reported from the Department are sent out accordingly, as is true of those of an educational nature. Both *Series* are widely distributed to libraries—public, special and school. Sufficient copies of pertinent educational material are produced for the libraries of the schools of Maryland and to meet the requests of teachers. Exchange of publications with workers and institutions in related work is encouraged with the result that the Department's library is receiving much current literature in the field of biology and conservation. This wealth of reference material, bound for permanency, serves a most useful purpose in the library at the Chesapeake Biological Laboratory.

The *Maryland Tidewater News,* a six-page monthly publication, was issued during the year in *Volume IV*. The *News* carries lively educational material relating to the Chesapeake Bay country with considerable emphasis on the problems of marine resources. Its mailing list includes the names of all of the State's licensed watermen and the libraries of schools from the elementary level to that of the university. Also, it is sent to the public libraries and to sportsmen's clubs in Maryland, to special lists of marine research workers, to conservation education people, to conservation agencies of other states, to civic leaders and to persons who have requested it for specific purposes.

G—ACKNOWLEDGMENTS

Much of the advancement made in the field of conservation research and education during 1948 should be credited to persons and agencies not permanently connected with the Department. The Office of Naval Research and the Naval Ordnance Laboratory made possible the further observations of effects of explosives on fish. The Conowingo Power Company continued to provide space, certain facilities and equipment for hydrobiological studies on the Susquehanna River. The Seidel Manufacturing Company provided wire of odd sizes with which to construct crabpots for self-culling experiments and, through the interest of Mr. W. T. Seidel, is attempting to produce a wire of such size, mesh and durability as to further this study. The Bethlehem Steel Company, the Glidden Company and the E. I. du Pont de Nemours Company provided funds during the year with which to implement a comprehensive survey of the Patapsco estuary, the Baltimore Harbor region.

A close association of the Department's personnel with representatives of the Virginia Fisheries Laboratory and The U. S. Fish and Wildlife Service has been maintained in several programs on the Chesapeake Bay, while the latter agency has aided in the problems of natural resource inventorying, as has the U. S. Forest Service. The Johns Hopkins University has developed, on a cooperative basis, the researches on Baltimore Harbor. The University of Maryland sponsored the class in conservation education and provided the credit, three semester hours, for the registrants. The Smithsonian Institution made possible the continuation of the study of the Chesapeake diatom flora. The several departments of the Board of Natural Resources and the State Soil Conservation Service provided experienced and well trained lecturers and field leaders for the class and workshop features of the Departments' educational work.

Dr. John S. Karling, Columbia University, spent considerable time at the Chesapeake Biological Laboratory during the year studying the fungi of the Solomons Island region. Mr. Paul S. Conger again was in residence at the Laboratory where he continued studies of diatoms of the Chesapeake Bay. Mr. L. M. Passano, Harvard University, conducted a series of observations on the physiology of crab molting. Mr. A. J. Fisher, Bethlehem Steel Company, offered valuable suggestions and help in connection with obtaining urgently needed experimental wire. Mr. David H. Wallace, Director, Department of Tidewater Fisheries, made available certain facilities and support for the applied researches. Mr. Ernest A. Vaughn, Director, Department of Game and Inland Fish, and Mr. Joseph F. Kaylor, Director, Department of State Forests and Parks, contributed substantially

to the resource inventory through assignment of personnel, facilities and funds.

A pond at the Lewistown Hatchery was made available for experimental work on shad fry and fingerlings by the Department of Game and Inland Fish, and the Superintendent at the Hatchery, Mr. A. M. Powell, provided certain local facilities. Mr. Edgar H. Hollis, Dr. Clinton Atkinson and Dr. O. Lloyd Meehan, of The Service, gave much time and effort, in regard to several of the Laboratory's problems such as tagging, migration, survival and other features, while the last named aided materially in the conduct of the Belvoir Hatchery.

Continued interest in the conservation education approach of the Department by the State Superintendent of Schools, Dr. Thomas G. Pullen, the County Superintendents and others in education administration in the State, has been responsible in a large measure for the success of the course, workshop and special meetings held for teachers, or by them, in order to obtain factual information on the conservation situations and to gather materials of use in the classroom.

The agencies and persons named here served to initiate or to develop and mature many features of the Department's program of research and education. Their contributions in financial support, in providing facilities and space, in sharing procedures and programs and in actual weeks or months of time spent at a laboratory table or in the field, collectively and severally have been great. The Commission of Research and Education wishes strongly and cordially to express the members' deep appreciation of the help given.

R. V. TRUITT, *Director*